SECTION A

1. (a) attempt to substitute into sum formula for AP **M1**

e.g. $S_{20} = \frac{20}{2}(2(-7)+19d), \frac{20}{2}(-7+u_{20})$

setting up correct equation using sum formula **A1**

e.g. $\frac{20}{2}(2(-7)+19d) = 620$

$d = 4$ **A1** **N2**

[3 marks]

(b) correct substitution $-7+77(4)$ **A1**

$u_{78} = 301$ **A1** **N2**

[2 marks]

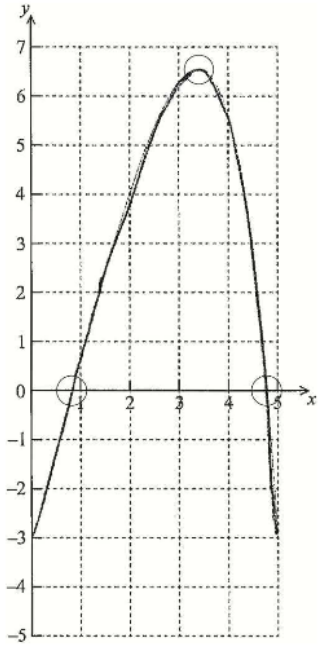
Total [5 marks]

2. (a) intercepts when $f(x) = 0$ **M1**

$(0.827, 0)$ $(4.78, 0)$ (accept $x = 0.827$ $x = 4.78$) **A1A1** **N3**

[3 marks]

(b)



A1A1A1 **N3**

Note: Award **A1** for maximum point in circle, **A1** for x-intercepts in circles, **A1** for correct shape (y approximately greater than −3.14).

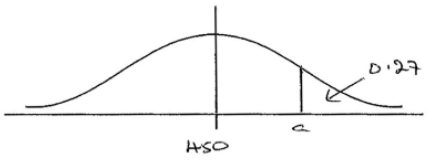
[3 marks]

(c) gradient is 1.28 **A1** **N1**

[1 mark]

Total [7 marks]

3. (a)



A1A1A1 **N3**

Note: Award **A1** for 450, **A1** for a to the right of the mean, **A1** for area 0.27.

[3 marks]

(b) valid approach **M1**
e.g. $P(X < a) = 1 - P(X > a)$, 0.73

$a = 462.256\ldots$ **A1**

$a = 462$ **A1** **N3**

[3 marks]

Total [6 marks]

4. (a) l_1 **A1** **N1**

[1 mark]

(b) $\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$ **A1** **N1**

[1 mark]

(c) choosing correct direction vectors **A1A1**
e.g. $\begin{pmatrix} 3 \\ -2 \\ 1 \end{pmatrix}, \begin{pmatrix} -1 \\ 2 \\ -a \end{pmatrix}$

recognizing that $\mathbf{a} \bullet \mathbf{b} = 0$ **M1**

correct substitution **A1**
e.g. $-3 - 4 - a = 0$

5. (a) (i) recognizing binomial with $n = 600$, $p = 0.4$ **M1**

$E(X) = 240$ **A1** **N2**

(ii) correct substitution into formula for variance or standard deviation **A1**

e.g. 144, $\sqrt{600 \times 0.4 \times 0.6}$

$sd = 12$ **A1** **N1**

[4 marks]

(b) attempt to find range of values **M1**

e.g. 240 ± 12 $228 < X < 252$

evidence of correct approach **A1**

e.g. $P(X \leq 251) - P(X \leq 228)$

$P(228 < X < 252) = 0.662$ **A1** **N2**

[3 marks]

Total [7 marks]

6. **METHOD 1**

appropriate approach **M1**

e.g. completed diagram

attempt at set up **A1**

e.g. correct placement of one angle

$\tan 30 = \frac{h}{x}$, $\tan 35 = \frac{h+1.6}{x}$ **A1A1**

attempt to set up equation **M1**

e.g. isolate x

correct equation **A1**

e.g. $\frac{h}{\tan 30} = \frac{h+1.6}{\tan 35}$

$h = 7.52$ **A1** **N3**

[7 marks]

METHOD 2

$\sin 30 = \frac{h}{l}$ **A1**

in triangle ATB, $\hat{A} = 5°$, $\hat{T} = 55°$ **A1A1**

choosing sine rule **M1**

correct substitution **A1**

e.g. $\frac{h / \sin 30}{\sin 55} = \frac{1.6}{\sin 5}$

$h = \frac{1.6 \times \sin 30 \times \sin 55}{\sin 5}$ **A1**

$h = 7.52$ **A1** **N3**

[7 marks]

7. (a) substitution into formula for area of triangle **A1**

e.g. $\frac{1}{2}r \times r \sin\theta$

evidence of subtraction **M1**

correct expression **A1** **N2**

e.g. $\frac{1}{2}r^2\theta - \frac{1}{2}r^2\sin\theta, \frac{1}{2}r^2(\theta - \sin\theta)$

[3 marks]

(b) evidence of recognizing that shaded area is $\frac{1}{8}$ of area of circle **M1**

e.g. $\frac{1}{8}$ seen anywhere

setting up correct equation **A1**

e.g. $\frac{1}{2}r^2(\theta - \sin\theta) = \frac{1}{8}\pi r^2$

eliminating 1 variable **M1**

e.g. $\frac{1}{2}(\theta - \sin\theta) = \frac{1}{8}\pi, \theta - \sin\theta = \frac{\pi}{4}$

attempt to solve **M1**

e.g. a sketch, writing $\sin x - x \mp \frac{\pi}{4} = 0$

$\theta = 1.77$ (do not accept degrees) **A1** **N1**

[5 marks]

Total [8 marks]

SECTION B

8. (a) $y = 10.7x \mp 121$ **A1A1** **N2**

[2 marks]

(b) (i) additional cost per box (unit cost) **A1** **N1**

(ii) fixed costs **A1** **N1**

[2 marks]

(c) attempt to substitute into regression equation **M1**

e.g. $y = 10.7 \times 60 + 121$, $y = 760.12\ldots$

cost $= \$760$ (accept \$763 from 3 s.f. values) **A1** **N2**

[2 marks]

(d) setting up inequality (accept equation) **M1**

e.g. $19.99x > 10.7x + 121$

$x > 12.94\ldots$ **A1**

13 boxes (accept 14 from $x \geqslant 13.02$, using 3 s.f. values) **A1** **N2**

Note: Exception to the **FT** rule: if working shown, award the final **A1** for a correct integer solution for **their** value of x.

[3 marks]

(e) (i) this would be extrapolation, not appropriate **R1R1** **N2**

(ii) this regression line cannot predict x from y, not appropriate **R1R1** **N2**

[4 marks]

Total [13 marks]

9. (a) $y = \frac{2x-1}{x+1}$

interchanging x and y (seen anywhere) **M1**

e.g. $x = \frac{2y-1}{y+1}$

correct working **A1**

e.g. $xy + x = 2y - 1$

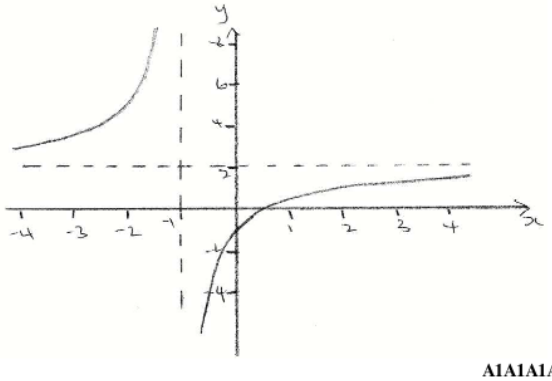
collecting terms **A1**

e.g. $x + 1 = 2y - xy$, $x + 1 = y(2 - x)$

$h^{-1}(x) = \frac{x+1}{2-x}$ **A1** **N2**

[4 marks]

(b) (i)



A1A1A1A1 **N4**

Note: Award **A1** for approximately correct intercepts,
A1 for correct shape, **A1** for asymptotes,
A1 for approximately correct domain and range.

(ii) $x = -1$, $y = 2$ **A1A1** **N2**

(iii) $\frac{1}{2}$ **A1** **N1**

[7 marks]

continued ...

Question 9 continued

(c) (i) area = 2.06 **A2** **N2**

(ii) attempt to substitute into volume formula $\left(\text{do not accept } \pi\int_a^b y^2 dx\right)$ **M1**

volume $= \pi\int_{\frac{1}{2}}^{3}\left(\frac{2x-1}{x+1}\right)^2 dx$ **A2** **N3**

[5 marks]

Total [16 marks]

10. (a) (i) 106 m **A1** **N1**

(ii) substitute $t = 4.5$ **M1**

$h = 44.9$ m **A1** **N2**

(iii) set up suitable equation **M1**
e.g. $f(t) = 30$

$t = 4.91$ **A1** **N1**

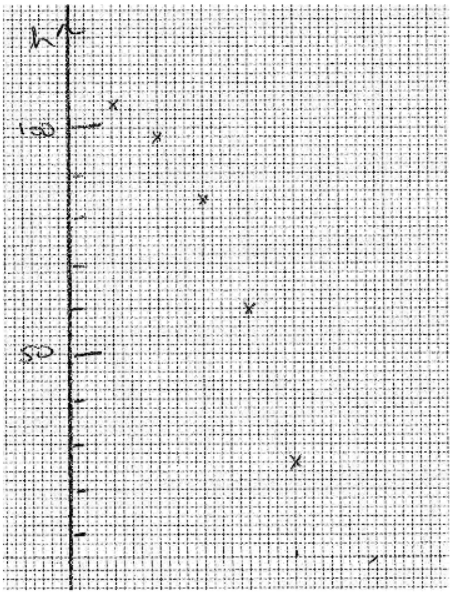
[5 marks]

(b) recognising that height is 0 **A1**
set up suitable equation **M1**
e.g. $g(t) = 0$

$t = 5.39$ secs **A1** **N2**

[3 marks]

(c) (i)



A1A2 **N3**

Note: Award **A1** for correct scales on axes,
A2 for 5 correct points, **A1** for 3 or 4 correct points.

(ii) Jane's function, with **2** valid reasons **A1R1R1** **N3**
e.g. Jane's passes very close to all the points, Kevin's has the rock clearly going up initially – not possible if rock falls

Note: Although Jane's also goes up initially, it only goes up very slightly, and so is the better model.

[6 marks]

Total [14 marks]